A Compact, High-Precision Optical Payload Enabling Earth-Sized Exoplanet Detection Using Nanosatellites

Completed Technology Project (2011 - 2015)

Project Introduction

The objective of the proposed research program is to design, build, test, and fly a compact, high-precision optical payload that is compatible with nanosatellite platforms. Nanosatellites (i.e. spacecraft weighing less than approximately 10 kg) hold the promise of low-cost access to space and more rapid development. On the other hand, nanosatellites impose severe mass, volume, and power constraints that make cutting-edge science difficult without additional technology development. Such a technology development is the subject of this proposal, encompassing optical design, integrated simulation, and model-based systems engineering. The proposed payload would fly as part of ExoplanetSat, a 3U CubeSat space telescope designed to detect transiting Earth-size exoplanets bright, Sun-like stars. Specific activities to be performed as part of this program are the development of a composite focal plane array combining CMOS and CCD imaging sensors for guide star tracking and science measurements, respectively; optimizing the sensor for high performance in the absence of active thermal control; developing a custom lens to serve as the optical telescope element; and creating a new tool that facilitates model-based systems engineering (MBSE) for small satellites. This work is significant to NASA in that the proposed technology development will allow low-cost platforms (e.g. CubeSats) to conduct meaningful science within their strict size, mass, and power constraints. The intended result is a game-changing shift wherein nanosatellites are able to make breakthrough discoveries for a fraction of the cost of traditional space missions.

Anticipated Benefits

This work is significant to NASA in that the proposed technology development will allow low-cost platforms (e.g. CubeSats) to conduct meaningful science within their strict size, mass, and power constraints. The intended result is a game-changing shift wherein nanosatellites are able to make breakthrough discoveries for a fraction of the cost of traditional space missions.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

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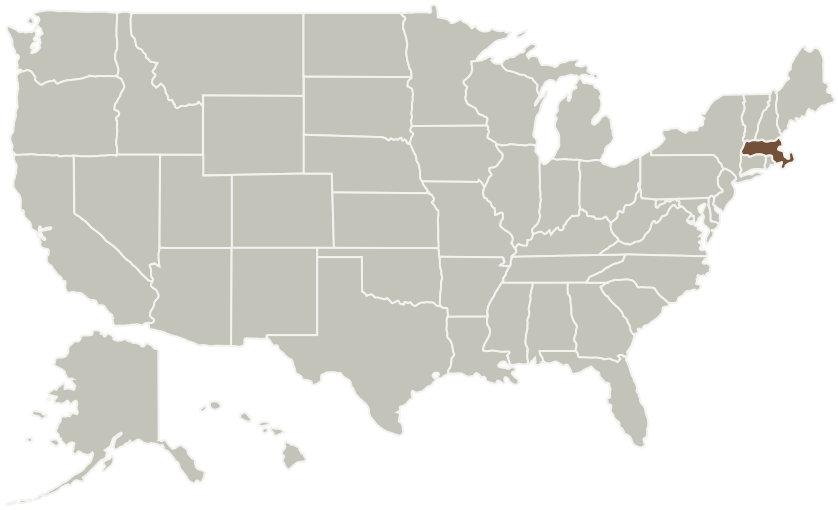
Primary U.S. Work Locations and Key Partners



Primary U.S. Work Locations
Massachusetts

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Project Management

Program Director:
Claudia M Meyer

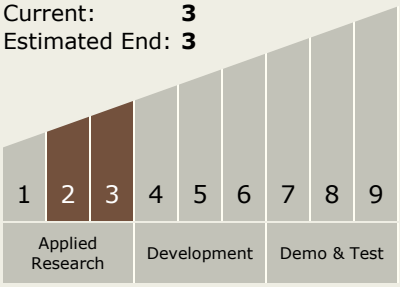
Program Manager:
Hung D Nguyen

Principal Investigator:
David N Miller

Co-Investigator:
Matthew T Smith

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.4 Attitude Estimation Technologies
    - TX17.4.3 Attitude Estimation Sensors